(2)

1993
Executive Research Project
S39

Industrial Policy: Meeting the Challenge (A Partnership with Industry)

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Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY N/A	3. DISTRIBUTION/AVAILABILITY OF REPORT Distribution Statement A: Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NDU-ICAF-93-039	5. MONITORING ORGANIZATION REPORT NUMBER(S) Same
6a. NAME OF PERFORMING ORGANIZATION Industrial College of the Armed Forces 6b. OFFICE SYMBOL (If applicable) ICAF-FAP	7a. NAME OF MONITORING ORGANIZATION National Defense University
6c. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000	7b. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Industrial Policy: Meeting the Challenge (A Partnership with Industry)	
12. PERSONAL AUTHOR(S) William S. Kaplan	
13a. TYPE OF REPORT Research 13b. TIME COVERED FROM Aug 92 TO Apr 93	14. DATE OF REPORT (Year, Month, Day) April 1993 15. PAGE COUNT 42
16. SUPPLEMENTARY NOTATION	
17. COSATI CODES FIELD / GROUP / SUB-GROUP	18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
19. ABSTRACT (Continue on reverse if necessary and identify by block number) SEE ATTACHED	
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Judy Clark	22b. TELEPHONE (Include Area Code) (202) 475-1889 22c. OFFICE SYMBOL ICAF-FAP

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

Abstract

Industrial Policy: Meeting the Challenge
(A Partnership With Industry)

by Lt Colonel William S. Kaplan, USAF

The economic and competitive challenges of the 1990s require us to take a different approach to achieve success than in the past. The defense budget and the defense-focused research and development expenditures of both industry and government are declining. At the same time, the technologically capable economic blocs of the world are stepping up the competitive pressure domestically and internationally.

These international competitors maintain the explicit, focused support of their governments. In a partnership, the public and private sectors in these countries work as a team to further their economic growth and security. In the United States, this teamwork does not exist. Our problem is one of leadership and accountability--leadership and accountability in both industry and government to deal with the incredible depth of resources we possess.

In the 1960s, explicit space policies and government-industry teamwork put a man on the moon and laid the groundwork in the 1970s for the successful shuttle program. In the 1980s, the explicit defense-focused policies of the Reagan and Bush administrations and a government-industry partnership developed and fielded a defense capability second to none. In the 1990s, only teamwork between government and industry will enable us to meet the global economic and competitive challenges that will mark us as a successful world-class economic power.

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DISCLAIMER

Industrial Policy: Meeting The Challenge

(A Partnership With Industry)

A Changing Focus

Increased international economic interdependency and strong, technologically capable competitors pose significant challenges to America in the 1990's. Economic, and not military competition, will be an increasing source of friction in our international relations. A significant cornerstone of our past success, both economic and military, has been our world preeminence in weapons technology and the economic growth and advancements this technology generated. With the Soviet threat greatly diminished, defense focused research and development spending, public and private, is showing a marked decrease. Our economic performance and international power and influence will increasingly depend on our commercial technology edge and the ability rapidly to convert this technology to compete successfully in world markets.

The growing high-technology countries of Germany and Japan continue to challenge the U.S. In many industries our edge is lost or slipping. The U.S.-owned consumer electronics and factory automation industries are virtually non-existent; our 50% share of the world machine tool market has been cut to 10%; and some argue the U.S. has not yet

regained the lead in the semiconductor industry we pioneered.[1]

Meeting the Challenge

Successfully meeting the challenge facing us depends on:

* the ability to refocus national resources and capabilities toward the research and development of critical non-defense technologies in industries supporting domestic and international growth, and

* the ability of the government and the private sector to work together to respond to rapid change.

The challenges are not new. By the 1980s, foreign productivity levels had converged on the U.S. and foreign corporations began to dominate in innovation[2]. Further, the budget deficits and restrictive monetary policy of supply-side economics led to high interest rates and expensive dollars overseas, increasing U.S. costs of production and decreasing the attractiveness of U.S. products. No broad-based government focus existed to support the economic and competitive growth of U.S. companies. We now lag our international competitors in the amount of real growth in research and development expenditures in many critical and emerging non-defense technologies. In real terms, we spend 1.9% ($94B) of our gross domestic product (GDP) on nondefense research and development while Japan spends 3% ($59B) of GDP and Germany spends 2.7% ($27B) of GDP.[3]

Shifting the focus of our research and development spending is necessary. In doing this, we are confronted with critical decisions affecting U.S. industrial and technological leadership. The direction we take affects our continuing ability to compete in the world marketplace into the next century. A national change in emphasis is absolutely essential and how we accomplish the necessary change raises several questions:

With the depth of resources at our disposal, why are we falling behind our international competitors?

What government policies, regulations or actions, if any, will provide the right direction for public and private investment in research and development to sustain a global competitive position?

Is An Industrial Policy An Answer?

What is "Industrial Policy?"

Industrial policy can be generally defined as government action, through either law, regulation or guidance to direct changes in international and domestic economic growth through the channelling of resources into specific sectors of the economy. In current literature, other terms used synonymously and with slight variation, include *technology policy, competitiveness policy,* and *innovation policy.*

US Industrial Policy?

Existing policy consists of an ad hoc group of regulation and policy. There are 12 executive agencies whose responsibilities support research and development[4] and seventeen congressional authorization and appropriation committees with significant legislative authority over research and development.[5] There are also 18 laws and several executive orders specifically enacted to support research and development.[6] The Office of Science and Technology Policy even issued "The U.S. Technology Policy" on September 26, 1990.[7] At

the highest level, the 1993 National Security Strategy of the United States[8] provides neither direct, specific reference to a national industrial policy nor reference to critical technology support or exploitation. A review of previous strategies also mirrors the current one.

Over the past forty years, government research and development policy manifested itself in spending decisions focused primarily on public goods such as defense, space, health, agriculture, synthetic fuels and social needs. Except in defense, the U.S. allowed foreigners to participate in its research. For example, U.S. antitrust law required AT&T to license its invention of the transistor to any foreign or domestic firm. Sony Corporation was among the first to be licensed. In addition, the government did not restrict multinational corporate technology transfer to overseas affiliates and subsidiaries. In our quest for free world markets, we supported GATT (General Agreement on Tariffs and Trade) and liberally provided most-favored-nation trading status to economic competitors.

Industrial Policy - Other Countries

Both Japan and Europe have extensive programs aimed at supporting and improving corporate performance.[9] In Europe, the Airbus consortium is successfully selling planes in the commercial airplane market and is subsidized to cover some of the production costs.

In Japan, the Ministry of International Trade and Industry (MITI) prioritized, through National economic vision statements, Japanese industrial sectors for development. The selected sectors received special financial, organizational and protectionist support from the government. MITI focused primarily on areas of U.S. technological strength such as semiconductors, computers, aerospace and biotechnology.[10] In addition, Japan has

maintained a high rate of savings and investment, a scientific and engineering-oriented education system, cooperative labor-management relations and a business-oriented culture. This explicit, central focus, supports corporate performance and economic power, growth and global competitiveness.

Research and Development Spending Patterns

Defense Technology As A Driver of Economic Growth

Technology has driven economic growth in the United States from the industrial revolution through the end of the cold war. Leadership in critical military technology and its application is the singular most important reason the U.S. is the preeminent military power in the world today. During the past 50 years, increases in Government support and spending on defense research and development translated to economic and military power- *necessarily at the expense of other areas.*

Patterns and Priorities

The patterns of federal research and development reflect a paradigm underlying government research and development priorities. Funding for non-defense areas has been steadily declining, from the launch of Sputnik in 1957, and in particular from Viet Nam through the defense build-up in the Reagan years as shown in Table 1 below:[11]

U.S. Federal Funding For Nondefense R & D
as per cent of National Total

1970	1975	1981	1985	1990
31%	29%	26%	17%	17%

Table 1

Source: Council on Competitiveness (1992)

For example, while the research and development budget for DOD increased in real terms by $11.4 billion between 1980 and 1990, funding for federal research and development at the Commerce Department, where many technology programs reside, declined $100 million.[12] Further, the mix between federal funding for defense and nondefense research and development during this period continued to change in favor of defense. Federal funding for defense research and development jumped from 47% of the government total to 61%, peaking in 1986 at 64% of total government research and development spending. Nondefense research and development spending fell from 53% of the government total to 39%.[13] In FY 1990, 90% of the $37 billion DOD research and development budget went to weapons development providing little benefit to commercial technologies.[14]

The limited funding the government did provide for non-defense research and development created an intense competition. In addition, corporations directed available funds towards technologies and products that provided an immediate return. This resulted in

an overall decrease in private research and development as shown in Table 2 below:[15]

Average Annual Real Change in Private R & D Spending

1975-80	1980-85	1985-90	1990-92(e)
6.1%	7.3%	1.6%	0.1%

Table 2

Source: National Science Board (1992)

Short-Term Focus

A short-term perspective held by American industry, driven by the bottom line and government spending patterns, tends to limit the long-term focus so essential for the research and development investment necessary to provide the technology for later product conversion. The government exacerbates this trend through the annual authorization and appropriation process with its inherent short-term focus.

A Complex Relationship - Research & Development and Innovation

Research and development is part of a larger, complex relationship -- the relationship between research, development and innovation. Research and development provides the

scientific and technical advances needed for innovation. Innovation is the introduction of new products and processes into the marketplace. Turning the discovery into a marketable entity is the key to economic growth here and in the world markets. The success of this process is a major determinant of our competitiveness.

The type of research plays an important role in this process. Basic research (6.1 and 6.2 in budget terms) is funded to provide fundamental knowledge and understanding of a concept or process and is the foundation of new technology. Payoff is long-term. Results are sometimes not predictable and are often not directly useable in the marketplace. However, it appears that there is a significant relationship between the amount of basic research a firm conducts as part of total research and development spending and increases in the firm's productivity.[16] Basic research provides product development opportunities whereby applied research can result in both product development and process innovations. Productivity and increased competitive ability can be the result.

Priority Setting Allocates Funds

Priority setting allocates the available funding at all levels of the government. At the top, the national security strategy determines the overall spending areas. National security requires the priorities, in the President's budget and in the congressional authorization and appropriation process, to allocate the funding to meet the overall security strategy. If it's not part of the strategy, the integrated focus required to allocate dollars based on national objectives, research goals and agency missions does not exist. The result is a research and development strategy, and budget, that is never considered as part of an overall plan. While

the industrial community is responsible for converting research and development into technology and then into final products, how the government structures the playing fields determines which business decisions are made and how industry will invest. It is clear that industry places its resources where the research and development funding is available. The money has been in defense technology and so have the returns.

Comparison of U.S. and Foreign Research and Development Expenditures

Consider the following:

* In absolute terms, the U.S. spends more than twice as much on research and development as does Japan, 4.5 times as much as Germany, and over 6 times as much as France and Great Britain.

* In relative terms, total U.S. research and development is 1.9% of GDP. Japan spends 3% of GDP and Germany spends 2.7% of GDP.

* Between 1980 and 1992, defense accounted for 60% of U.S. Government research and development spending. By contrast, in 1989, government research and development in Japan was only 9%; in Germany only 19%; in France 42%; and in Great Britain 55%.

* In 1992, 0.2% of the total U.S. federal research and development budget was directed at research and development directly relevant to commercial technology; in Japan, 8% of the total research and development budget supported commercial technology; and in Germany, 19% of the total research and development budget supported commercial technology.[17]

There have been some spinoffs from defense technology advances that have impacted commercial technology (e.g. the jet engine, the computer and the integrated circuit). In sharp contrast to our leading competitors, the data shows we have focused most public research and development dollars towards government and defense rather than the commercial markets.

The U.S. Position

Without the defense burdens that we have carried in the past, other countries have been investing both publicly and privately in critical, commercial technology and its application. Our task is to examine where we stand internationally in the areas that will determine our competitive and international economic success. Then we must expand our economy as a result of action in the global marketplace that does not rely mainly on defense technology.

In examining the erosion of the U.S. lead in critical technologies, a recent report from the Council on Competitiveness suggests that we will have a difficult time. The report identified critical generic technologies driving the U.S. economy as well as our relative international competitive position in these technologies. The technologies cut across nine major sectors of the economy and account for over $1 trillion in sales. The technologies identified fall into five groups:

* materials and associated processing technologies
* engineering and production technologies
* electronic components
* information technologies
* powertrain and propulsion technologies.[18]

The council's report concluded that *...the strong U.S. position of a decade ago has deteriorated significantly. U.S. industry has already lost several technologies that are critical to industrial performance and is losing badly in several others.*[19]

Japanese Focus: Key Reasons for Their Current Success

Research and development in Japan, for example, has been focused not so much on

radical technology but rather on product and process refinements, improved manufacturing technology and improved product quality.

It is in manufacturing that the U.S. has experienced a large trade imbalance.[20] U.S. pre-eminence in many manufacturing industries is evaporating because the Japanese use technology far more effectively than we do. Robert B. Reich points out that

> *... breakthroughs generally mean less to a nation's economic or military might than the speed and success with which they are absorbed, improved upon, and incorporated into new products and processes.*[21]

Edward Mansfield of the University of Pennsylvania found that U.S. companies differ from their foreign counterparts in the organization and mix of their research and development. Where the U.S. firms emphasize product technology, the Japanese firms emphasize process technology. U.S. firms devote 67% of research and development funds to new products and product changes and 33% to new processes and process changes. In Japan, these ratios are reversed.[22] Process technology advancements lead to new equipment and facilities. Japanese companies invest twice the amount that U.S. firms do in tooling and manufacturing equipment and facilities. U.S. companies invest twice the amount the Japanese do in preproduction marketing rather than engineering.[23]

Japanese productivity growth is also high because of the high rate of capital investment in various industries made possible by savings rates much higher than in the U.S.. This leads to lower costs of capital. The result is rapid adoption of new, state-of-the-art technologies and increases in growth. Innovation drives their success, both in product and process development.

Also, Japanese industrial policies have been guided for many years by a process of

developmental capitalism where the state, represented by MITI, works closely with private enterprise to further economic development.[24] MITI focused on the development of high-technology industries, guided by the belief that the market alone would not ensure a supply and demand for technology as well as sufficient return to develop the new technologies. Through state-sponsored research, research and development tax credits, generous depreciation allowance and MITI-approved export cartels, MITI focused Japanese industry on improving the world-wide Japanese manufacturing capability.

Reasons For the Erosion in U.S. Technology Leadership

(National Science Board Study and Others)

Broad based industry and government studies, surveys and interviews have produced a wealth of data. The reasons are at the same time simple and complex and not sudden in nature.

The technological lead we enjoyed during the quarter century after World War II was destined to diminish. Our technological lead and our economic leadership were in part due to the devastation and destruction of European and Japanese industry. They have rebuilt their industries and now pose significant challenges to our continued leadership and success.

The National Science Board has been studying this issue and surveyed 250 companies in different fields. The Board's report identified five major reasons for the erosion of U.S. leadership:

* general management practices
* external financial pressures
* changing global technological environment
* technology management practices

* federal technology policy.[25]

In addition to the reasons identified in the report, two other areas help explain why U.S. technology leadership is on the decline:

* human resource and technical education issues
* innovation rate declines.

General Management Practices and External Financial Pressures

General management practices and external financial pressures are inextricably linked. It is no secret that U.S. businesses are under pressure to maximize the return to the investor and to return immediate profits. During the past ten years, the high cost of capital has also challenged businesses as they chose between investing dollars in research and development to commercialize their products and in pursuing market shares of new and existing markets. The Council on Competitiveness supported this observation and noted

> *...many of the areas where the United States is weak reflect the effects of high capital costs; the lack of cooperative relations between equipment, materials and components suppliers and their customers; and an underemphasis on manufacturing.*[26]

Changing Global Technological Environment

The changing global technological environment was primarily characterized as having a ... *growing difficulty of controlling enough technological competitive advantage to sustain an entry barrier* and *declining lead times and faster product turnover cycles.* [27] This increases the risk that companies will be unable to recover investments and provide the return the investors require before the product is rendered *old* technology or the manufacturer is able to establish a market share.

Technology Management Practices

Technology management practices translate to product conversion. The board report verified what the newspapers and magazines have been saying for several years. U.S. companies do a poor job of commercialization of technology and are often not the first ones in the market with a competitive product. The real crisis becomes apparent when industry fails to commercialize the technology and move it to the marketplace. Benefits accrue only when these new products are sold in the marketplace or the product is used to increase quality or productivity. To say that technology drives economic growth and competitiveness is only partly true. Failure to exploit the technology or apply it efficiently is equally as important to the outcome.

The National Science Board study reported, for example, that Japanese companies required on average only half the number of engineering hours and two-thirds the time of U.S. companies to transform a concept into a product ready for the sales floor. More importantly, the study reported that *inadequate fundamental engineering research* and a *reluctance to invest in new enabling technologies...* was a primary reason for U.S. slowness in translating basic engineering results into innovative products.[28]

Federal Technology Policy

Lack of a long-term strategy for expanding the economy through technological competitiveness was a major issue highlighted by the National Science Board. Primarily, the issue centered on a lack of coherent, public policy to support any long-term strategy.

Human Resources and Research and Development

Education and training of future scientists and engineers is critical to having the ability necessary to develop new technology and to translate the engineering results into marketable products. The number of scientists and engineers engaged in research and development, as a per cent of the labor force, is higher in the U.S. than anywhere else. However, Japan now exceeds the U.S. in graduating engineers with Japanese universities graduating 76,362 engineers compared to the U.S. graduating 70,406 engineers. [29] This is significant since Japan's workforce is only half the size of ours and translates into nearly twice the engineering graduates, per capita, entering the civilian work force.

In 1988, 20% of graduating U.S. engineers went to work for defense industries.[30] Compared to the small number of engineers entering the very small Japanese defense sector, this reduction in engineering talent to U.S. industry is significant. *Engineering* talent, as opposed to *scientific* talent, is the key to translating Japanese research and development into marketable products. As Lt Colonel Robert Gamache, ICAF Class of 1993 and an MIT graduate observed:

Scientists study the world as it is, Engineers create the world that never was.

Also, secondary schools in the U.S. ranked 14th in mathematics skills compared to their international counterparts. Hong Kong ranked first and Japan ranked second.[31] These basic skills are essential to the computerized automation in manufacturing as well as the analysis required for innovation resulting from research and development.

Downward Trends in Technological Innovation

Innovation is essential to competitiveness. From 1950 through the 1970s the share of U.S. innovations compared to the total number of innovations worldwide declined (Figure 1).[32]

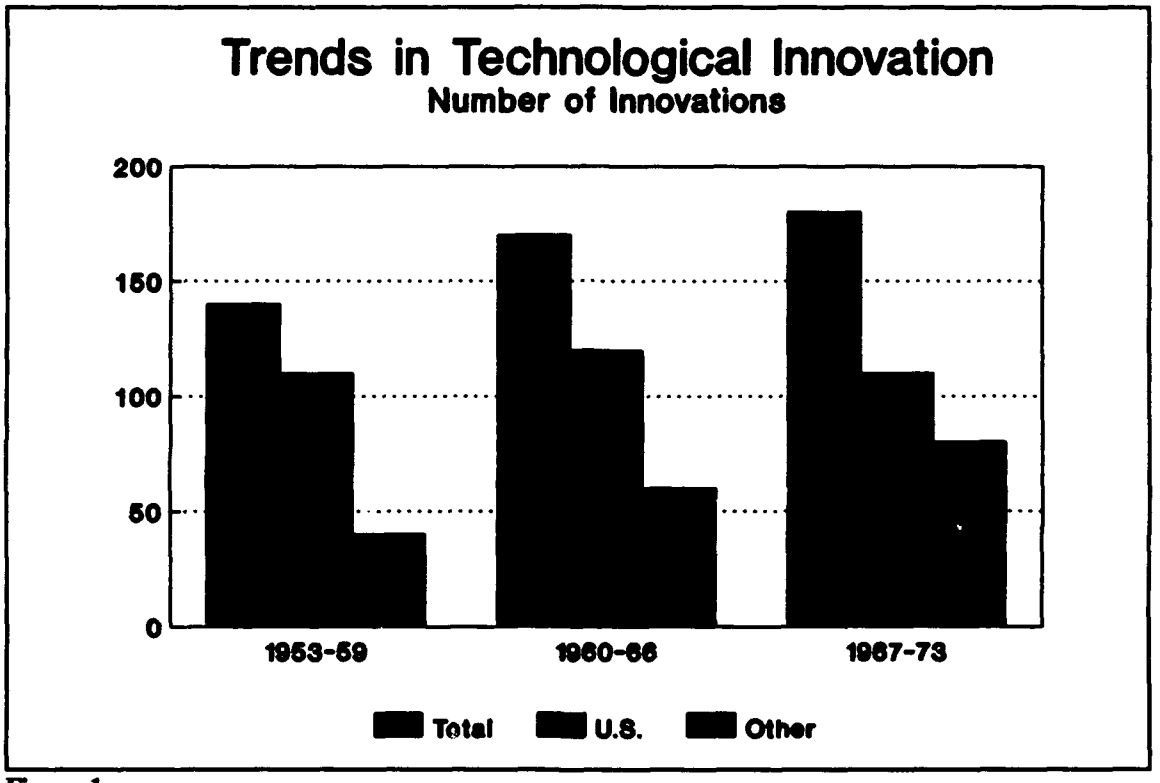

Figure 1

Source: National Science Board (1992)

Supporting former dominance and further decline is the declining number of U.S. patent applications and grants. By 1988, foreign originated patents accounted for 50% of

total U.S. patents granted (Figure 2).[33] A study by the Office of Technology Assessment (OTA) found that even though research and development spending has risen steadily, the effectiveness of that spending has declined. Publications by U.S. authors in scientific and trade journals has also fallen steadily compared to world totals.

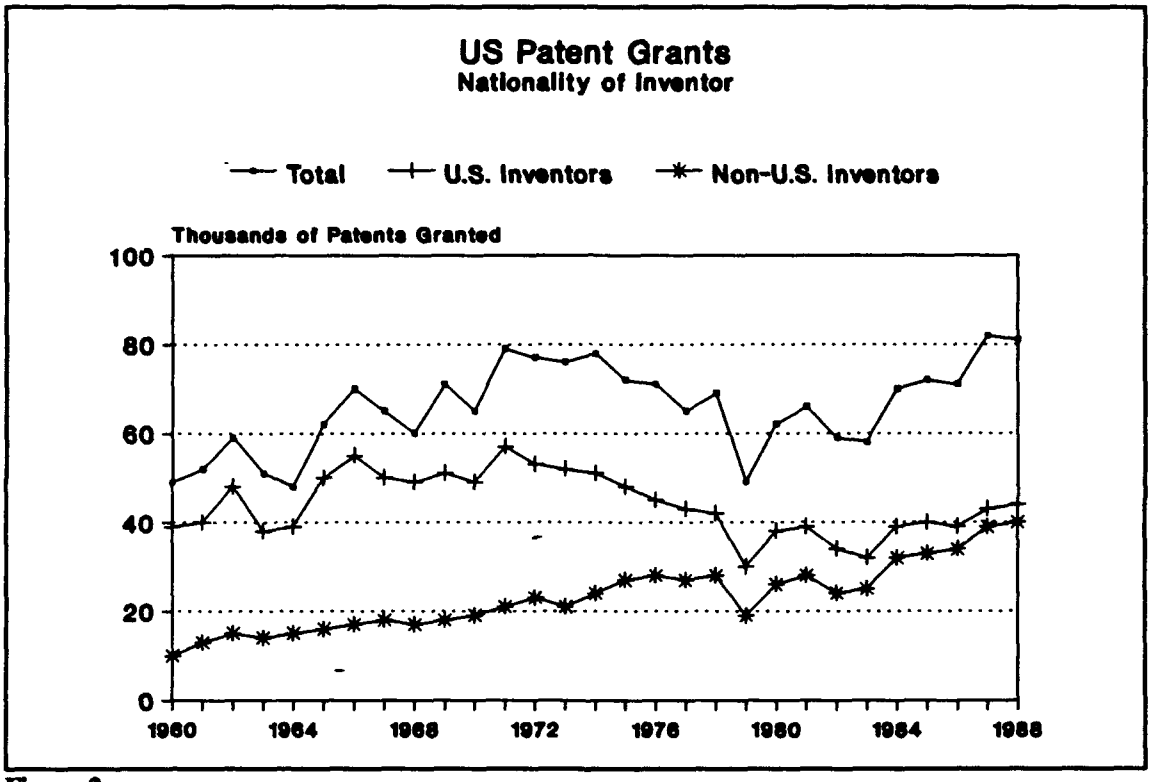

Figure 2

Source: National Science Board (1992)

The Current Role of Government In Support of Research and Development

As discussed earlier, government research and development funding historically reflects a consistent paradigm. Government funding has been limited to missions and technologies that are clearly the responsibility of the government; namely, public goods. Defense spending already discussed is the clearest example. This traditional view of research and development holds that basic research is a central government responsibility while market-oriented activities involving applied research and development belong to the private sector. This appears consistent with the past several administrations in their reliance on defense for economic growth and on the market forces for other areas. It is often a case of serendipity when defense research and development results in civilian benefit such as in the computer and aerospace industries. We have relied on the private sector for increases in applied research and development through strong economic recovery, specific research and development incentives and removal of barriers to private research and development. The government accomplishes this through such mechanisms as changes in the tax laws concerning capital equipment investment and tax credits for investment. Relaxation of anti-trust restrictions on research and development joint ventures, such as Sematech, are other areas.

Consistent with demonstrated spending patterns, the government views the research, development and market timeline as a linear continuum of activities stretching from science to market.[34] Basic research is at the pure science end while production research and process development is closer to the market end. It would seem to lend itself, in this

pipeline concept, to a clear breakdown for focusing on what and where the government research and development dollars will be spent (allocation and priority). The danger lies in an arbitrary dissection of roles and responsibilities along the continuum and leads to gaps in research and development spending at critical junctures. If the government primarily supports "basic" research in those technologies supporting public goods while industry supports research and development where they will get the most immediate return, it is likely resource allocation to technology development will come up short on the commercial side. This seems especially true when the research and development expenditures of individual firms are unable to generate a market to support the investment or the market to generate the return is believed to be too far into the future.

Observations

** Commercially focused research and development is not a priority in our current national security strategy.

** There is no explicit, overall public policy baseline to support this focus.

** The narrow focus of government research and development must change. Leadership in military technology research and development will no longer drive productivity and economic growth.

** The narrow focus of business on research and development investment must change. The short-term, bottom-line approach to research and development must be replaced with a long-term approach.

** Innovation is absolutely essential to global competitiveness and economic success. Research and development success is only part of the story.

** U.S. Government priorities must include support for the changes U.S. business must embrace to remain competitive in leading areas and recover in declining areas.

** A team approach involving industry and government is required.

An Answer to Global Competitiveness -- National Industrial Policy?

Real economic growth in the U.S. has slowed considerably. In the past ten years almost without exception, GDP has been increasing at a decreasing rate. In 1981 GDP increased by 11.9% and in 1991 by only 2.9%.[35] An examination of the trade balance for the past 20 years reflects an annual increase in the deficit from $5.7 billion in 1972 to an annual increase of $101.7 billion in 1990.[36]

The United States must increase its productivity if it is to continue to raise the standard of living and at least maintain, but more importantly, increase its global competitiveness. Advances in technology are a significant means of increasing productivity often allowing the producer to compete with a quality product at or below the existing price. Efficiency and lower production costs are often the result. However, more important than the development of technology is its application. It is now widely accepted that

> *...from one-third to one-half of all [U.S.] growth has come from technical progress, and that it is the principal driving force for long-term economic growth and the increased standards of living of modern industrial societies.*[37]

Industrial Policy Viewpoints Examined

What must be done? An explicit industrial policy is suggested by some and rejected by others. There are two basic views:

1. Industrial policies should be defined that bring all the economic factors together.
2. Economic success and global competitiveness can be achieved through the free market system with little or no government interference.

Industrial Policy -- Yes

Major proponents of the industrial policy answer include Lester Thurow, Ira Magaziner and Robert Reich. The general belief is that U.S. companies and the government should develop together an integrated and coordinated industrial policy that *picks the techno-winners and protects the losers.* These policies would have as their goals the channelling of investment dollars to industries that are on the cutting edge of technology and providing other government assistance via regulatory or statutory changes to the nation's business framework. Simultaneously, declining industries, the losers, would benefit from government directed reforms on corporate policies and managerial practices as well as regulatory protection from outside competition.

Lester Thurow characterizes industrial policies as

... both an expression of and a vehicle for bringing about a strategic consensus among government, industry, and labor as to the basic directions in which the economy ought to be moving. Such a strategic consensus allows each of the individual decision makers to undertake actions that will jointly increase the likelihood that all the economies actors will be successful in reaching their desired collective and individual objectives. Business might, for example, promise new investment and labor changes in work rules if government were willing to help finance additional research and development expenditures in a particular industry. Or government might promise changes in the tax code which would make it easier to finance new start-up ventures if labor and business would agree to restrain wage and price increases.[38]

Industrial policy also has the following attributes:

* The government partially finances civilian cooperative industrial research on new products or processes.

* The government takes action to lower capital costs and increase the availability of capital.

* Government has a plan to deal with declining industries and relies on industry to develop a recovery plan but cooperates in their success through legislation or other regulatory support.

* The market framework by itself will not consistently enable the U.S. business community to solve its competitiveness and productivity problems.

* There is a consciously designed strategy to enable the U.S. to compete globally. This will help reduce the trade deficit.

* There are specific, critical technology areas identified by government and business that are targeted for support. Infant industries in areas important to national security need protection and support so they can be competitive. If essential to national security, this technology and its products must always be available.

Industrial Policy -- No

Charles Schultze, in his article "Industrial Policy: A Dissent,"[39] and others opposed to industrial policies make the following arguments:

* American industry performs well globally when measured against other countries including employment and productivity. The steel and automobile industries, with their deep seated structural problems, are not typical of the rest of American industry.

* American labor and capital can make the transition required as economies, markets and technologies change. In our market economy, competitive forces will channel resources into their most productive uses.

* Japan is not necessarily a true example of industrial policy in action. Contributions of MITI and industrial policy to success of Japanese industry are overstated. Government did not provide leadership and direction, rather it provided an accommodating and supportive environment. Any central planning was limited to a few industries only.

* The U.S. Government does not have the requisite economic criteria necessary to be able to identify what constitutes a "winning industrial structure."

* The U.S. Government does not have the ability to identify the technology and product areas in which a country will be successful. Success is a combination of entrepreneurial skill, momentum and coincidence.

* Politics cannot be separated from picking "winners" and "losers." The government cannot effectively allocate the resources.

* Getting monetary and fiscal policy in order to support a balanced recovery and decreased deficits will do more for American business and global competitiveness than

trying to define an industrial policy.

* Industrial performance is a factor of technological progress, labor-management relationships and stability of world markets all of which are beyond the control of government.

* Other arguments pertaining to "infant industry" protection and national security don't hold up. The Soviet threat is virtually non-existent and situations where these technology products must be available should be infrequent.

* Policies that purport to increase productivity and competitiveness in critical industries will not reduce the trade deficit. Trade deficits can appear in countries with high-productivity and competitiveness.

* A U.S. industrial policy would not be an effective counter against foreign industrial policies. The support of the same critical technology areas identified by other countries will not necessarily benefit U.S.industries. Though foreign subsidies and economic support to their industry would change the comparative advantage to U.S. industries, there should not be any permanent damage to U.S. industry unless the foreign industry achieved a monopoly in this area. Besides, how is it determined that a sector of the economy has the potential expected?[40]

* U.S. Industrial Policy will not fix the economy.

A Perspective
(Leadership and Accountability)

National policy decisions deal primarily with ***leadership and accountability.*** With regard to national industrial policy, ***leadership and accountability in both industry and government to deal with the incredible depth of resources that we possess in the United States.***

Though we do not have a coherent, centrally structured industrial policy to guide government and business through these challenging times, a de facto policy exists. It is an *implicit rather than an explicit policy.* The groups of organizations, regulations and policy

spread throughout the government have in fact established an implicit policy of technical growth and prosperity. This implicit technology policy, implemented through allocation of research and development dollars, was largely and successfully defense focused. The innovations in defense are astounding to which the stealth fighter, the B-2 and the advances in space communications, surveillance and intelligence gathering attest.

However, implicit policies generally fail when different players in the process act in a contradictory manner. Where Congress supported the SEMATECH consortium and steel initiatives, the Carter, Reagan and Bush administrations all opposed government influence in private-sector decisionmaking. This policy hindered private sector, long-range planning and resulted in confusion and loss of time and resources.

New Directions--The Partnership With Industry

Recent history demonstrates that revitalization of critical technology sectors and creation of domestic and international markets for these technologies is a difficult task. A sense of greater realism is absolutely essential in order to protect, support and provide for the self-sustainment of these sectors. Europe and Japan continue to aggressively support their own industries in the current world-wide recession.

The temporary relief Government protection and support mechanisms would provide here by themselves do little to enhance a firm's long-term competitive strength. Individual firms own the responsibility to take advantage of the improved environment through intelligent economic and fiscal decisions relating to cost, capital investment plans and the conversion of technology to competitive products. The individual firm's decisions provide

the long-term structure and strength necessary to be competitive. ***To begin, government action is the necessary first step. To continue and successfully achieve strong, competitive, high-technology industries, explicit government-industry cooperation and a link between corporate strategy and industrial policy are essential.*** A more defined, government focus on this sector is required.

Learning From Competitors

Japanese success has depended for decades upon an explicit industrial policy focused on a political and economic system that encourages technology initiatives, development, and implementation through a government-industry partnership. MITI, as a government steering organization, has the ability and purpose to formulate long-range plans, preferential to Japanese national industry, that can be implemented as part of an overall national economic and competitive international strategy. Christopher Freeman, in "Technology Policy and Economic Performance," discusses the relationship in Japan and emphasizes the

> *...importance of an integrated national system of innovation, which includes MITI as trailblazer, a firm-level R&D strategy that includes willingness to carry out reverse engineering on imported technology, the role of education and training to provide skilled workers to complement and use new technologies effectively, and the conglomerate structure of Japanese industry which facilitates risk-taking and adoption of innovations while insulating firms from short-term performance pressures.*

The infrastructure described does not exist in the U.S. However, there are actions the U.S. can take to support critical industrial sectors that begin to confront the issues argued by both the proponents and opponents of industrial policy:

A Team Approach to Sector Identification

Industry and government must jointly identify the industry sectors on which to focus. An arrangement similar to the "base closing" process may be a start because it attempts to eliminate the politics in making the hard decisions.

Specific Industry Financial Support

The federal government could appropriate additional funds to support joint research and development teams, upgrading existing plant and equipment and financing customer purchases of necessary systems and equipment. A successful example of this focus in the U.S. may be the NCMS, the National Center for Manufacturing Sciences. NCMS supports industry-wide cooperative research initiatives to develop improved machine tools, software and methods. It is funded 65% from industry and 35% from government. Government also provides support through the Man Tech program and lets industry decide the research direction, a major difference from MITI.

Separate from federal support, state governments could provide state grants, local tax benefits, and other favorable investment arrangements. This may or not be in conjunction with federal support and may even be in technologies for which federal support is not available. Media reports consistently demonstrate the successful marketing of state and local industries domestically and internationally. The SCRA, the South Carolina Research Association and its Rapid Acquisition of Manufactured Parts (RAMP) program is an excellent example of state sponsored research and development into the automated manufacturing sector.

Controlling Market Access

It may be essential, and appropriate, to limit market access for foreign products in uncompetitive or developing industry markets. However, protectionist policies are not the answer by themselves. Milestones and measures of success should be defined to aid in determining how long these measures should remain in effect. This is critical in order to avoid overprotection and preclude overreliance on these measures by individual firms. These supported industries would be expected to become self-reliant through this assistance and the exploitation of the advantages conferred by such policies.

Increase Sector Productivity and Competitiveness

Given this temporary protection and support, targeted industries would begin a long-term program of investment in plant and equipment, including new purchases and upgrading of existing plant and equipment. The government would ensure that funds are available for this investment given the economic considerations of this plan and the uncertainty of the short-term fluctuations in business cycles. This provides the necessary investment funds for plant and equipment and stabilizes the cash flow necessary to take a company through the business cycles. With fluctuations in business cycles, private funding cannot automatically be expected on a continuous basis. Taking advantage of this support and with some control over financial risk, individual firms must exploit these temporary advantages, not only through a capital investment program, but also through reductions in costs of materials, wages and other expenses such as overhead. This combination of greater efficiency, cost control and improvement is essential for the sector to be self-supportive,

productive and competitive.

Government Sources of Funds

Funding for firms in the sector could come from a financial arrangement similar to that set up by the Small Business Administration (SBA) to help qualified small businesses compete for government contracts. Loans could be guaranteed. Also, in a distinct departure from the SBA model, outright loans would be made with milestone defined payback schedules and conditions. Funds could also be provided through investment tax credits in those technology areas jointly agreed upon between industry and government as showing the most promise. Further, outright subsidies could be provided in sectors deemed critical for competitiveness and security until they were able to sustain themselves.

Tax Policy Support

Encourage private technology-related investment by reducing the capital gains tax in selected sectors as well as permanently providing for a tax credit for both basic and applied research and development experimentation.

Transfer Federally Funded Technology

It is essential for the federally-funded laboratories to collaborate with industry in product conversion of publicly-funded technology initiatives. This is fertile ground for the establishment of consortia and joint ventures. In addition, publicly-funded research in universities provides another avenue for technology development. (Some of these are tenets

of the Federal Technology Transfer Act of 1986 (P.L.99-502)).

Eliminating or Simplifying Regulations and Policy Barriers

Industry and government should jointly review existing regulation and policy that may be considered a barrier to research, development and innovation. Included is existing anti-trust regulation and barriers to joint ventures.

Increasing Interest in Science and Engineering Education

The decreasing numbers of engineering graduates portends a problem for the insertion of new ideas from universities and the research and development areas they pursue. In addition, the increasing requirements for a technically educated and competent workforce includes vocational and technical training. A fully-funded, long-term plan not only for enabling those who seek this training, but also for encouraging those who don't, must be developed to supply the resources required by increasingly and technically complex industries.

Pointing the Way

The government, in concert with groups from the targeted sectors, could point industry firms in promising directions. Through federally funded research and jointly funded cooperative research and development among firms in this industry sector, industry would examine new technology that could later be developed and converted to competitive product lines. With this positive climate of investment support and reduced risk, firms would be

encouraged to move in new directions. Additionally, as the sector strengthened its position in world markets, the U.S. government could act as a catalyst for further initiatives for establishment of overseas markets for this new technology and its product conversion. This could include sharing of economic intelligence.

The Answer Is Policy And Process

The increasing globalization and merging of economies and markets requires a reassessment of our economic policies, an examination of the requirements necessary for successful global competition, and a review of the direction that current policies are taking us. The leading economic blocs of the world recognize that the research and development process, its technologies, and the exploitation of the technology are critical to economic and competitive strength.

Lester Thurow stated that ***Industrial policies are to a nation what strategic planning is to a firm.***[41] A roadmap is necessary for all the players along with a jointly determined industry-government vision of where we want to be and when we want to be there. This concept, embraced at the micro level in the elements of "Total Quality Leadership," is providing new organization and direction for elements of the government and corporate America. Not only is a macro view required, but also so is a balance. It is essential that government inputs to this process and any subsequent policy decisions do not attempt to micromanage an individual industry or firm.

There is no single solution to the problems facing U.S. industry and there can be no single policy. To be successful, any policy must involve government assistance--but it must

be industry-led and not government dictated. It must focus on issues that cross industry sectors and have a common basis in a majority of them. Further, it must involve all participants with a stake in the outcome including our educational institutions. Finally, it must be structured to ensure the long-term, self-support of the firms within the industry sector.

In the past, our domestic economy and our policies and processes have not kept pace with fundamental changes in the global economy. Our competitive edge has eroded. However, we have both the ability and the resources to meet the competitive and industrial challenges to our economic security in the 1990s. Let's get on with it.

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